Alexander Pond Monitoring Report

By Mitzi Wickman, Charles Wickman, and Will Harling

Background & Introduction

The Alexander Pond is located approximately 2.8 miles up Seiad Creek from its confluence with the Klamath River. This was the first off-channel feature constructed by the Mid Klamath Watershed Council (MKWC) and was completed in October, 2010. Funding for this project came from US Fish and Wildlife Service Partners Program and the National Fish and Wildlife Foundation (NFWF)/PacifiCorp Coho Enhancement Fund. The landowner, Thomas Alexander, supports this project and has signed a landowner agreement permitting pond construction and follow-up monitoring and maintenance for 10 years, with the potential to renew the landowner agreement before it lapses.

MKWC began project planning for the Alexander Pond in 2009. Field reviews with the Karuk Tribal Fisheries Program, landowner Tom Alexander, Rocco Fiori (Fiori GeoSciences, Inc.), US Fish and Wildlife Service (USFWS), NOAA Restoration Center, California Department of Fish and Wildlife (CDFW, US Forest Service and others helped to inform data collection needs prior to construction. MKWC performed a topographic survey, installed cross sections throughout the proposed outlet channel and the pond, dug three water quality monitoring wells within the perimeter of the off channel feature in the summer of 2009, and took monthly dissolved oxygen (DO) and temperature readings from these wells. Based on our analysis, we found that the feature would likely have good DO levels, a range of suitable water temperatures for rearing coho salmon, and adequate volumes of water. Prior to construction, all necessary permits were secured, including a Section 1602 Streambed Alteration Agreement from CDFW, Clean Water Act Section 401 certification from the State Water Resources Control Board, National Environmental Policy Act documentation from USFWS, and Clean Water Act Section 404 dredge and fill permits from the Army Corps.

Figure 1. MKWC, Karuk Tribe, Fiori GeoSciences Inc., and the contractor review excavation plans (Sept, 2010) design concepts for Alexander Pond.

Project Objectives

Alexander Pond was constructed to augment limited winter rearing habitat for coho salmon in Seiad Creek. Off-channel habitats such as this provide juvenile coho refuge from high stream flows in the winter, and most constructed habitats also provide refugia from potentially lethal Klamath River mainstem water temperatures in the summer and fall. While the Alexander Pond was constructed solely for winter rearing habitat, ongoing bi-weekly water quality monitoring and population estimates show that coho also utilize this pond for summer rearing as well. The pond is located directly below the mouth of Canyon Creek, a tributary to Seiad Creek with

extensive coho spawning in the lower 1500 feet of the creek. The Alexander Pond connects to the first large pool downstream of this spawning reach.

Construction

The project was implemented in late September and early October of 2010 with oversight from Fiori GeoSciences, Inc, the Karuk Tribal Fisheries Program (KTFP), MKWC, and CDFW. Pond construction was completed by ABC Logging (Butch Crocker) using a 35,000 pound excavator and a dump truck. The site was not able to be pumped dry during excavation due to the large size and inflow of groundwater. Instead the pond was dug wet, then allowed to settle for three weeks prior to manual connection with Seiad Creek. Large tree boles with stumps were placed at various depths with complex assemblages of small woody debris pinned underneath to increase habitat complexity. Large boulders were used to armor the access channel in anticipation of future flood events. Fill was placed along the edge of the slope and was used to create an access for the landowner and monitoring crews to the river bar and the pond. During construction, the original footprint was adjusted to avoid removal of an old growth cottonwood tree that was initially planned to be an island in the center of the pond. The middle of the pond was narrowed and shifted to the north further away from the creek around the root mass of the cottonwood.

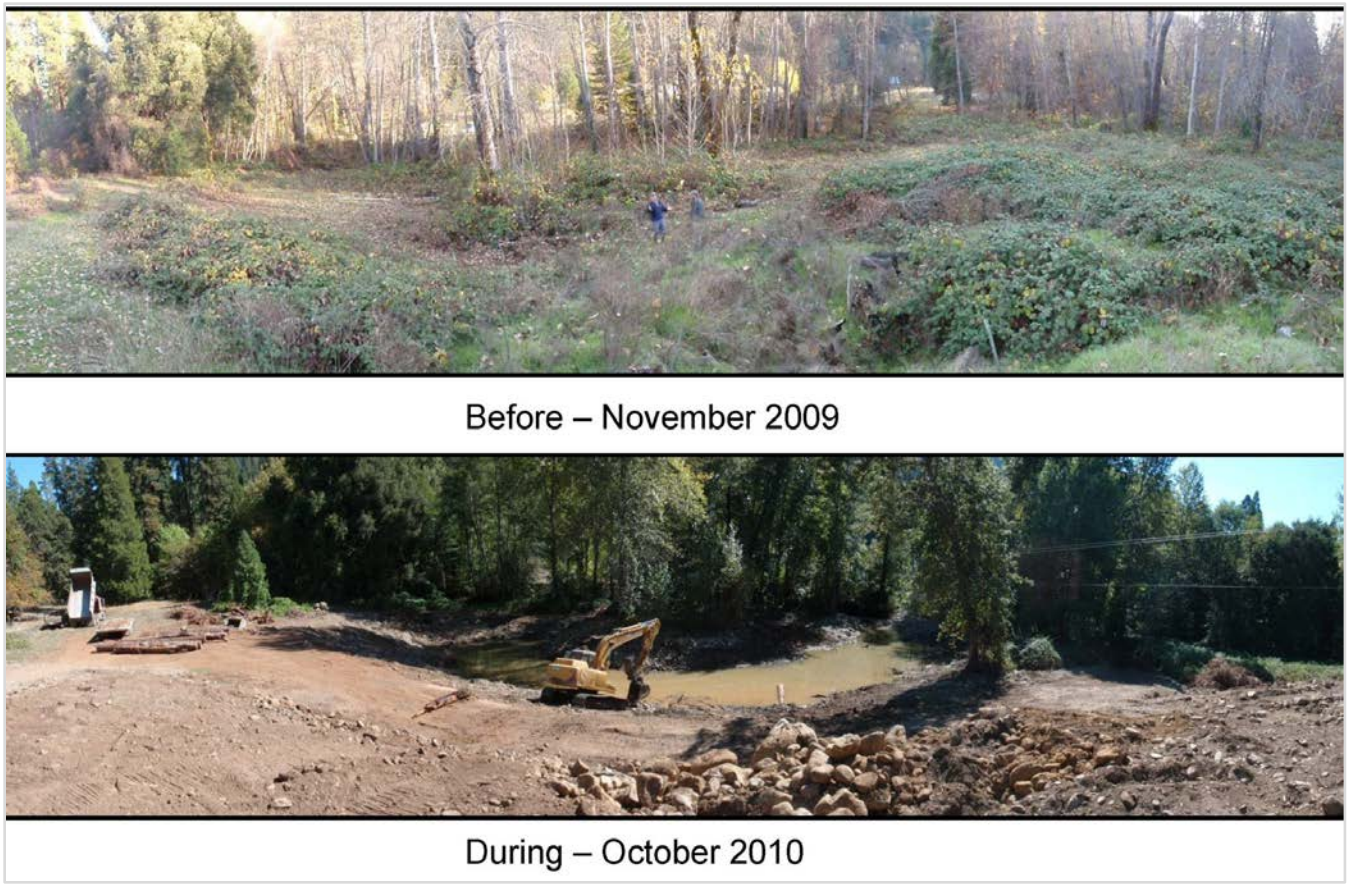

Figure 2. Before and during construction photos of Alexander Pond.

Figure 3. Riparian planting workday at Alexander Pond on October 3, 2010.

Figure 4. After construction of Alexander Pond, photographed in February 2011.

The wetted area of the constructed habitat is 8,167 square feet during base flow conditions. This increases by nearly 1,000 square feet during average winter flows. There is an ingress/egress channel at the lower end of the site connecting it to a pool in Seaid Creek. The terminal end of the channel is approximately one foot wide during low flow conditions and approximately 10 feet wide during high flow conditions. Alexander Pond has a maximum depth of 10 feet and averages six feet through the center line. The bathymetry is scalloped to provide varying depths for cover and forage habitat. Two of the large logs used in this project did not have stumps attached, and were not buried deep enough during construction. These logs are now free-floating in the pond after winter high flows dislodged them from the bank of the pond.

Immediately following construction, native grass seed and weed-free straw were spread with a combination of hand work and hydro-seeding with the Karuk Tribe's Watershed Restoration

crew, thus helping to minimize erosion. Since then, successive plantings with local schools and other partners have sped up the process of riparian vegetation establishment.

Monitoring

MKWC has coordinated with the KTFP and Humboldt State University (HSU) to conduct biological and physical monitoring of the Alexander Pond and other constructed habitats from the time they were built to present. MKWC Fisheries staff monitors each off-channel project site twice each month for DO levels and temperature. In addition, bi-weekly ocular fish counts approximate the number of fish utilizing each site.

A YSI 550A handheld DO/Temperature meter is used to collect samples at predetermined locations at each off-channel site, including adjacent tributaries. At Alexander Pond, temperature and dissolved oxygen readings are taken at four separate locations with three readings at each location to capture effects from stratification. Limited readings for short one to two month periods of time were collected with a datasonde for Alexander Pond, and include information on temperature, DO, and turbidity.

Figure 5. Fisheries Program Co-Director Charles Wickman records water quality data at Alexander Pond (Feb 2013).

The KTFP has conducted quarterly Petersen mark/recapture population estimates at the Alexander Pond and all other off-channel habitats constructed by MKWC since 2010. Additionally, MKWC and the KTFP worked with HSU Fisheries Program graduate students under the direction of Professor Darren Ward to collect movement data at Alexander Pond with a PIT tag array/reader loaned to the KTFP from the USGS. HSU graduate student Shari Witmore collected extensive data from Alexander Pond on coho abundance, growth, and movement in and out of Alexander Pond. Following up on Shari's work, Michelle Krall is in the process of answering some of the questions raised in Shari's thesis, such as: 1) What individual site characteristics of these off-channel habitats determine coho growth rates and movement? 2) What are juvenile coho eating in what proportions and how does this vary throughout the year?

Shari's thesis titled "Seasonal growth, retention, and movement of juvenile coho salmon in natural and constructed habitats of the mid-Klamath River" was accepted, and she is currently seeking to publish in a scientific journal on this work. Her findings on summer and winter growth rates and population abundance at Alexander Pond and other natural and constructed

sites are summarized later in this document. Her thesis can be found online at: http://humboldt-dspace.calstate.edu/handle/10211.3/124018. Of particular note, Shari found that pond depth was statistically significant when correlated to coho retention and population density. Michelle Krall's work is ongoing, and will help to inform pond design considerations in

Results

Fish Population Estimates/Dive Counts

Alexander Pond provides excellent summer and winter refuge for coho juveniles. Shari Witmore, in her thesis presented to the faculty of Humboldt State University, estimated the summer (May 2012 – November 2012) population of coho juveniles to be 154 fish and the winter (November 2012 – March 2013) population of coho juveniles to be 862 fish at Alexander Pond using the Petersen mark/recap method. In addition to Shari Witmore's thesis data, the Karuk Tribe Fisheries Program has been conducting Petersen mark/recapture studies on all of the ponds from the winter after they were constructed. The Lincoln Petersen Method was used to estimate population size, which required two sampling events in a closed environment within a three day time frame. The Karuk Tribe Fisheries Program conducted all of the mark/recapture field work and data entry.The following figure shows the results of population estimations by both Shari Witmore and the KTFP for Alexander Pond.

Dive counts were done in conjunction with water quality sampling efforts every other week. Two divers enter the rear of the pond and proceed towards the outlet in lanes, counting juveniles by species. Dive counts are always rough estimates due to 5-10 foot visibility and high population numbers. These can be considered more presence/absence, or general abundance counts that help determine the best timing for the quarterly mark/recap efforts. The low fish counts from snorkeling can be attributed to low visibility (a combination of excellent cover and presence of suspended plankton), or when not contradicted by mark/recap estimates in the same time period, lower fish numbers.

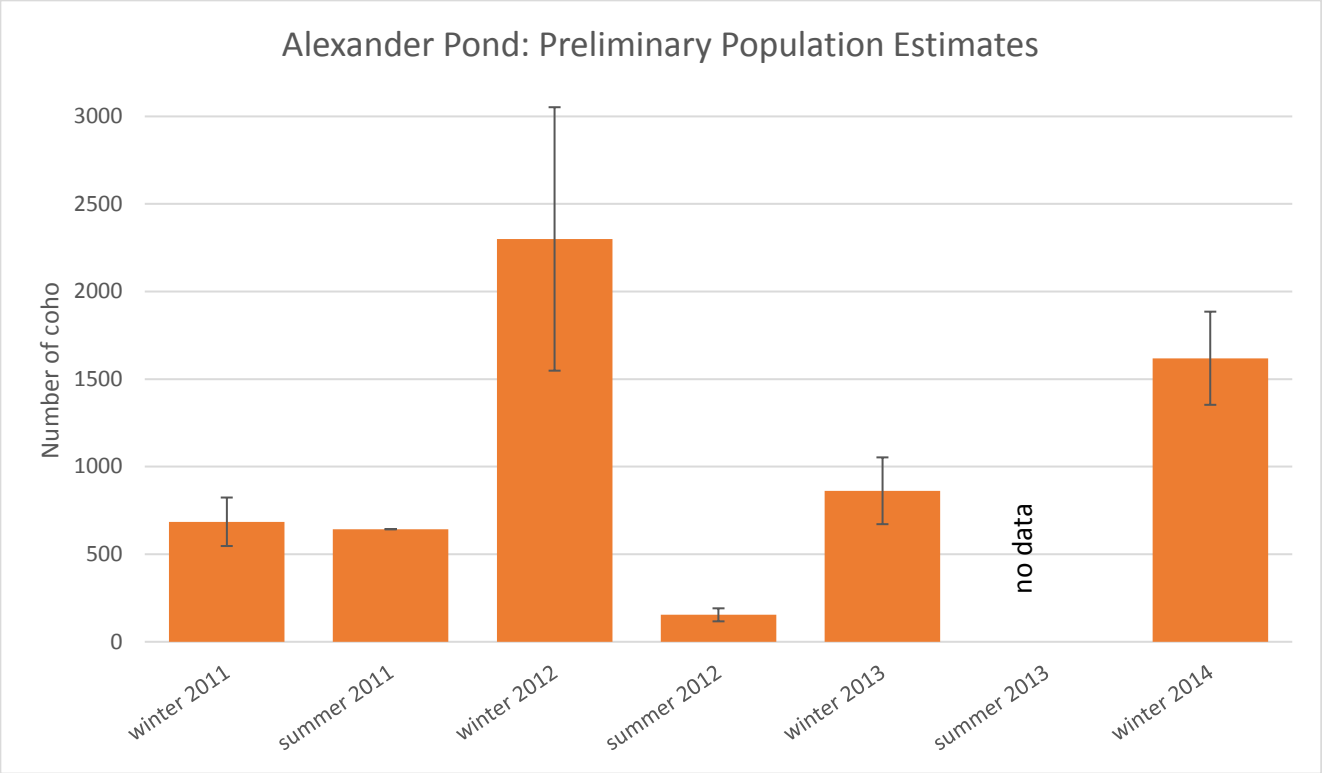

Figure 6. Preliminary population estimates for Alexander Pond from its first winter in 2011 through the winter of 2014. Data from Karuk Fisheries and Shari Whitmore using Petersen mark/recap method.

Water Quality Sampling and Dive Counts

The following five figures summarize the water quality sampling results for Alexander Pond. The temperature graphs were created from HOBO logger data in the pond and in Seiad Creek and from the Karuk Tribe's datasonde in the Klamath River. As shown in Figure 5, DO ranged from 4.54 mg/L to 12.63mg/L, and temperatures ranged from 4.22 degrees Celsius (C) to 18.38 degrees C, which are within the range of suitable conditions for coho found in the literature. DO meaurements were variable and were typically higher in Alexander pond in the winter than in the summer (Figure 5). Even at the low range of DO measurements recorded, coho salmon were observed using the pond.

During the winter, the water temperatures in Alexander pond were slightly warmer than Seiad Creek but stayed below 10 C. During the summer months, Alexander Pond was cooler than the mainstem Klamath River (Figure 6). The diel fluctuations of temperature in Alexander Pond were far less than Seiad Creek throughout the summer and winter, and stratification within the pond allowed coho to choose the temperature most suitable for them. Not having to compensate for significant diel temperature fluctuations is a metabolic savings for coho that is reflected in the increased growth rates for coho utilizing Alexander Pond versus coho using Seiad Creek. Additionally, warmer winter water temperatures allowed coho in Alexander Pond to more actively feed through the winter months, further augmenting growth rates. These generalities are complicated by data showing fish moving between the pond and the creek to maximize their growth based on bioenergetic principles we do not yet fully understand.

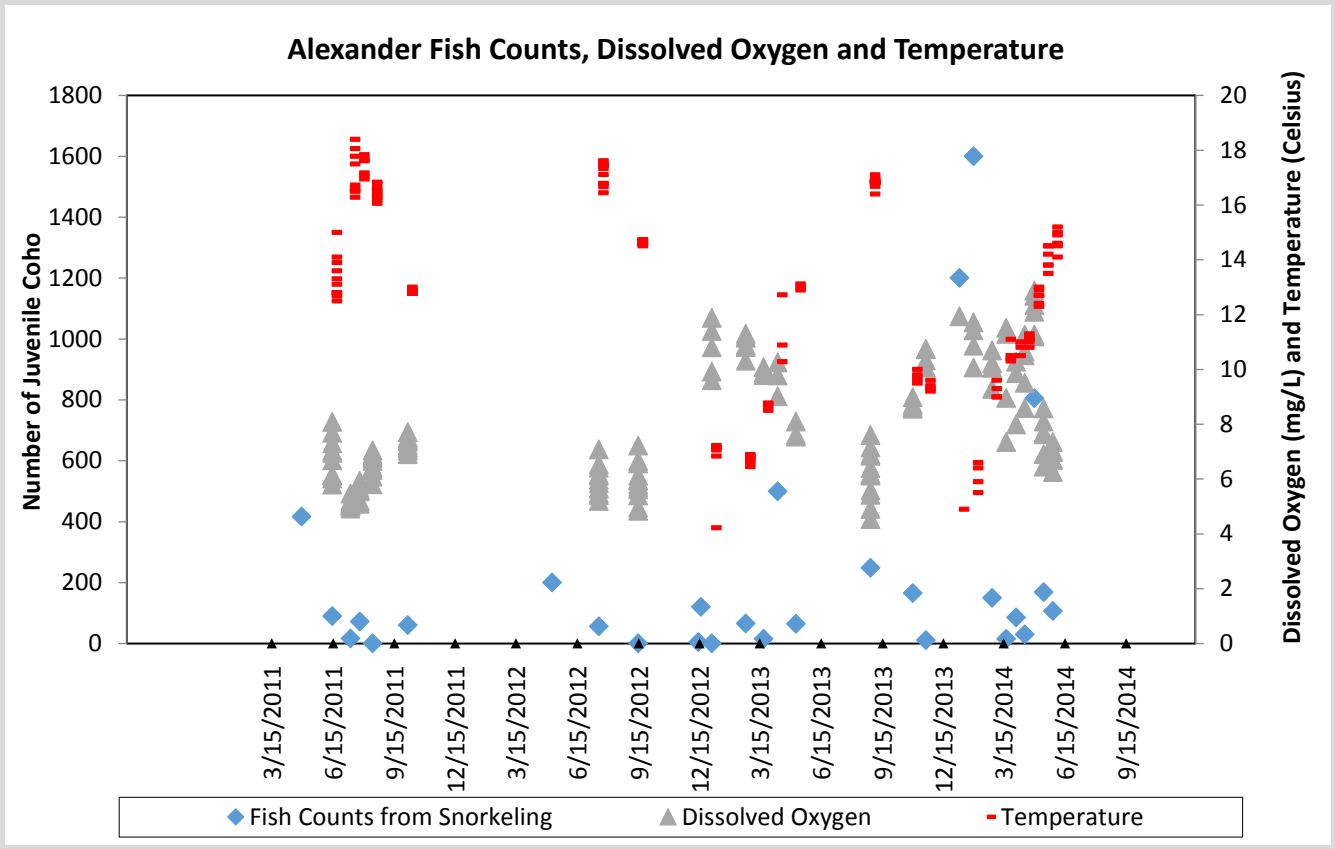

Figure 7. Number of fish observed via snorkeling and dissolved oxygen and temperature from a handheld YSI 550A instrument to track water quality in Alexander Pond from the spring of 2011 through the spring of 2014.

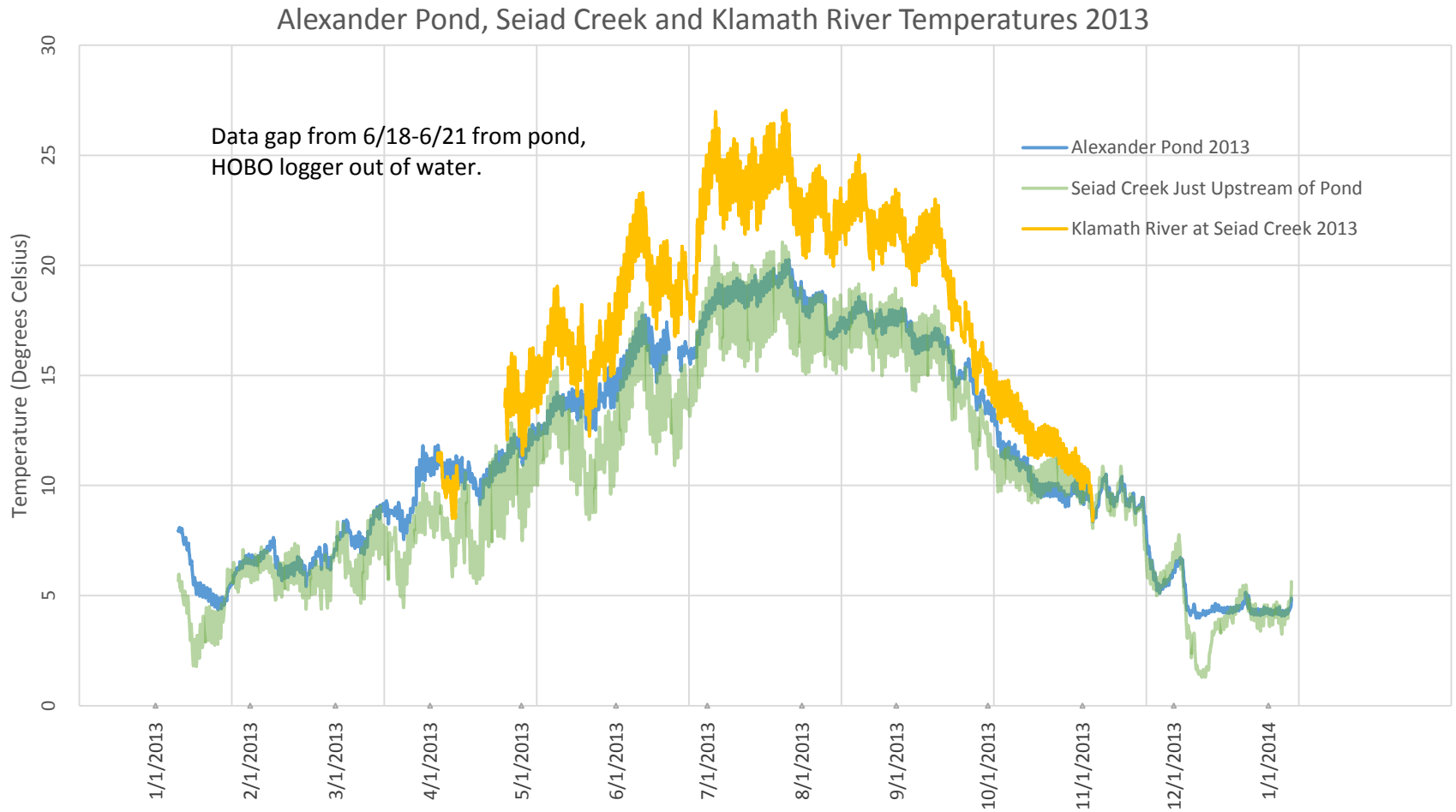

Figure 8. Alexander Pond and Seiad Creek temperatures from HOBO loggers and Klamath River temperatures from the Karuk Water Quality Program's DataSonde for 2013. Grapho shows Alexander Pond provides suitable thermal refuge for rearing coho salmon year round, and less diel variation and higher winter temperatures than adjacent Seiad Creek.

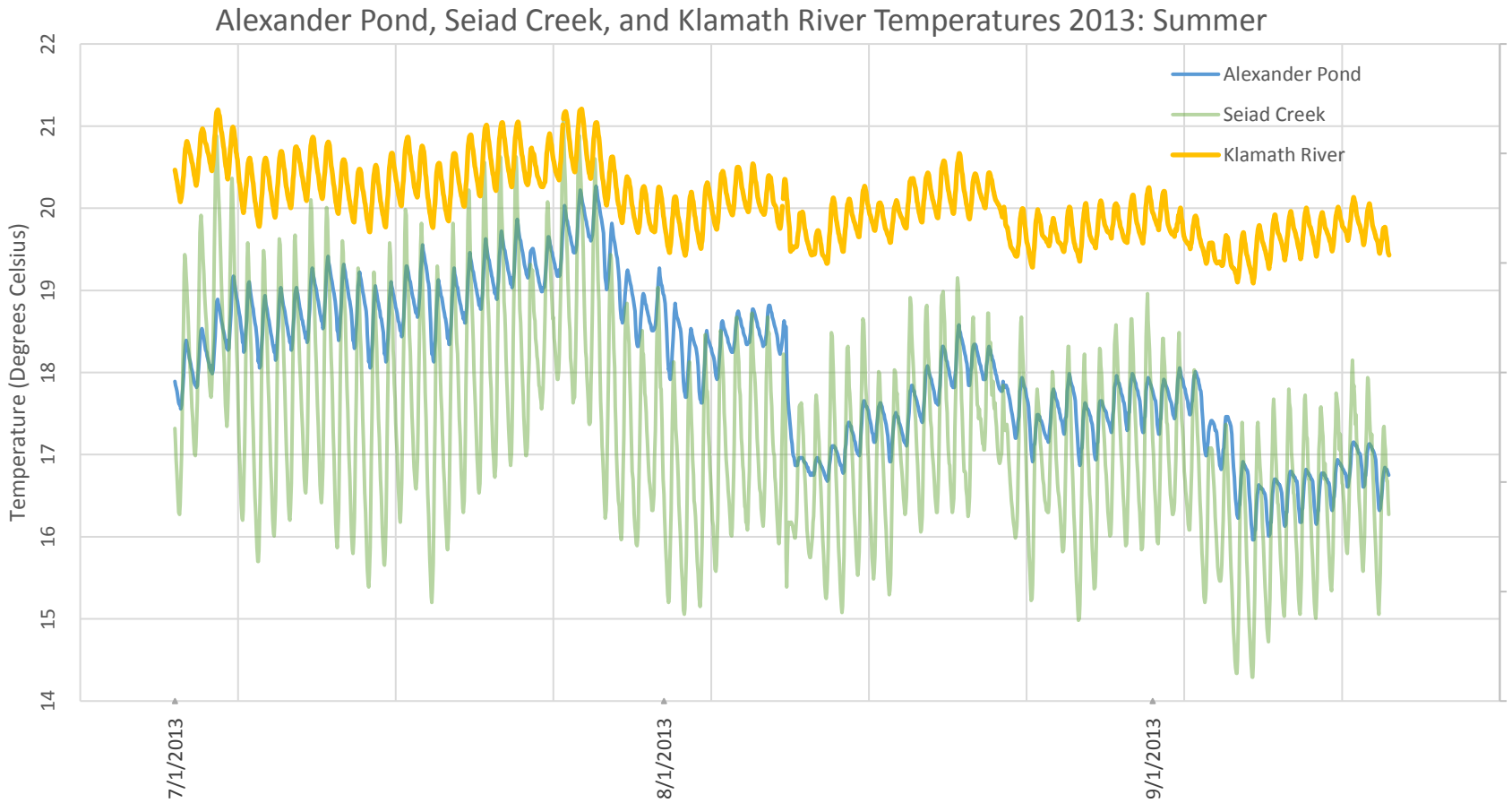

Figure 9. Alexander Pond and Seiad Creek temperatures from HOBO loggers and Klamath River temperatures from the Karuk Water Quality Program's DataSonde for summer 2013 (July 1st-September 15th).

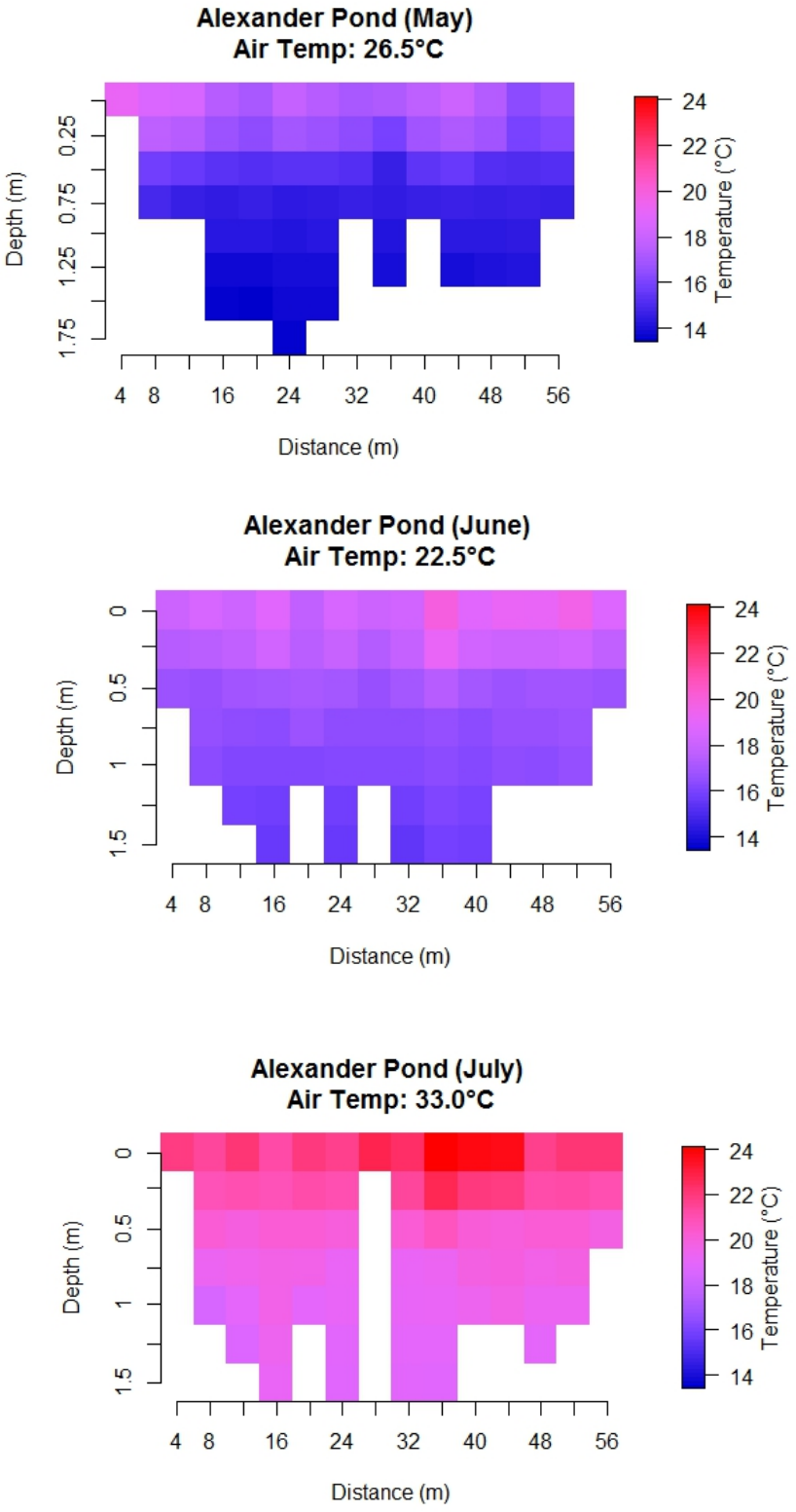

Figure 10. Alexander Pond temperature stratification May through July, 2014. Data collected from multiple depths along the pond centerline every four meters. (Krall, raw data, 2014).

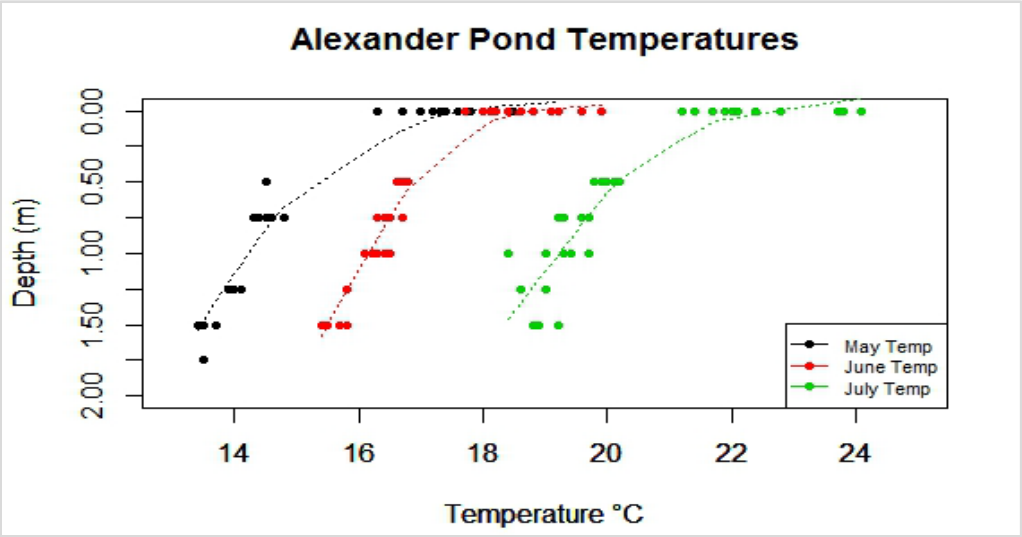

Figure 11. Alexander Pond graph showing temperature variation at various depth readings and locations in the pond between May and July 2014. (Krall, raw data 2014).

Juvenile Coho Growth Data

The Karuk Tribe Fisheries Program (KTFP) has conducted quarterly population estimates on Alexander Pond beginning in February, 2011. Both during and between these population estimates, juvenile coho were seined and tagged by the KTFP, allowing them to construct growth rates for individual fish based on days at large between PIT tagging and recapture measurements of growth and weight. Fish were seine netted, then transferred to buckets with a bubbler, anesthetized, then measured and weighed and returned to a recovery bucket before release back in to the pond. The following graph (Figure 12) shows growth rates for individual fish over various numbers of days measured in terms of millimeters per day of growth.

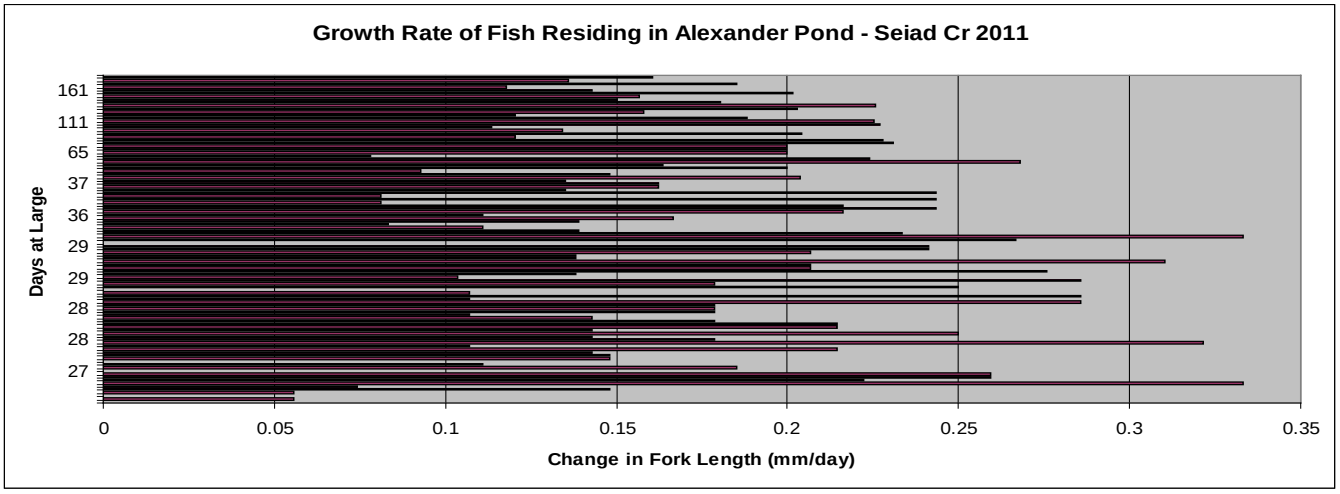

Figure 12. Growth rates for individual coho seine netted and recaptured from Alexander Pond between February, 2011, and August, 2011, after varying days at large. (KTFP, unpublished data 2012)

HSU graduate student Shari Witmore continued this work with the KTFP in 2012 and early 2013, and summarized this data in her 2014 master's thesis. She found that during the summer (May 2012 –

November 2012) the growth rate of coho juveniles was estimated to be 0.006+-0.0007 g/g/day and the winter (November 2012 – March 2013) growth rate was estimated to be 0.005+-0.0005 g/g/day at Alexander Pond (Figure 9).

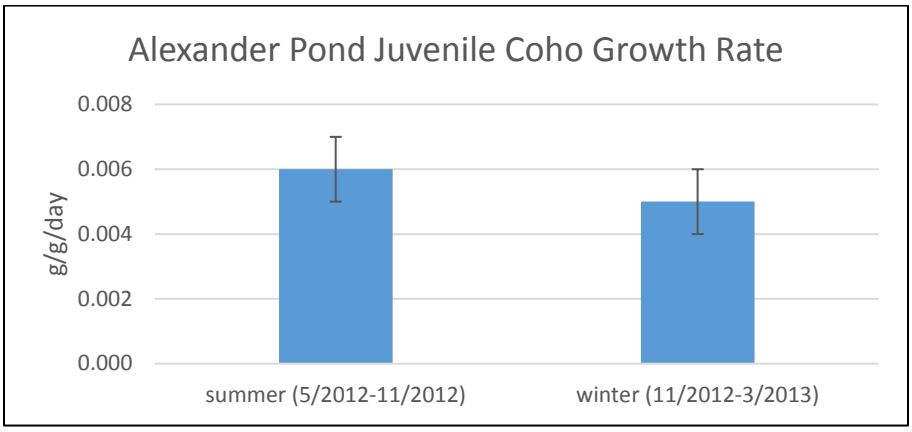

Figure 13. Data from Shari Witmore's thesis showing averaged summer/fall 2012 and winter 2013-2013 juvenile coho growth rates in Alexander Pond.

Natal and non-natal coho use: Passive Integrated Transponder (PIT tag) info

MKWC and the KTFP utilized the United States Geological Survey's (USGS) Klamath River Basin Pit Tagging Database to better understand non-natal juvenile coho movement to and from the constructed off-channel habitats (see Figure 14). The KTFP submits pit tag data to the USGS from their arrays, including one at the mouth of Seiad, and at the Lower Seiad and May Ponds. The first round of querying has led to some interesting observations. A 65 mm coho tagged in the Lower Seiad Pond on May 30, 2012, was detected in Lower Seiad Pond as an 83 mm fish on January 15, 2013. That fish swam up Seiad Creek over two miles and utilized Alexander Pond (code 985 121028850374). Data from Shari Whitmore's thesis shows a juvenile tagged at the mouth of Tom Martin (likely a Shasta or Scott River fish coming down the mainstem Klamath) was recaptured in the Lower Seiad pond, demonstrating non-natal coho use in Seiad Creek.

Five adult coho were detected at the MUX arrays at the mouth of Seiad Creek in November of 2012 that had either been tagged in Alexander or had spent time rearing in Alexander Pond, demonstrating that coho in the Mid Klamath have been returning to areas of the basin where they reared as a juvenile. Further querying of this Klamath River Basin Pit Tagging Database will further our understanding of coho movement, growth and pond utilization and effectiveness.

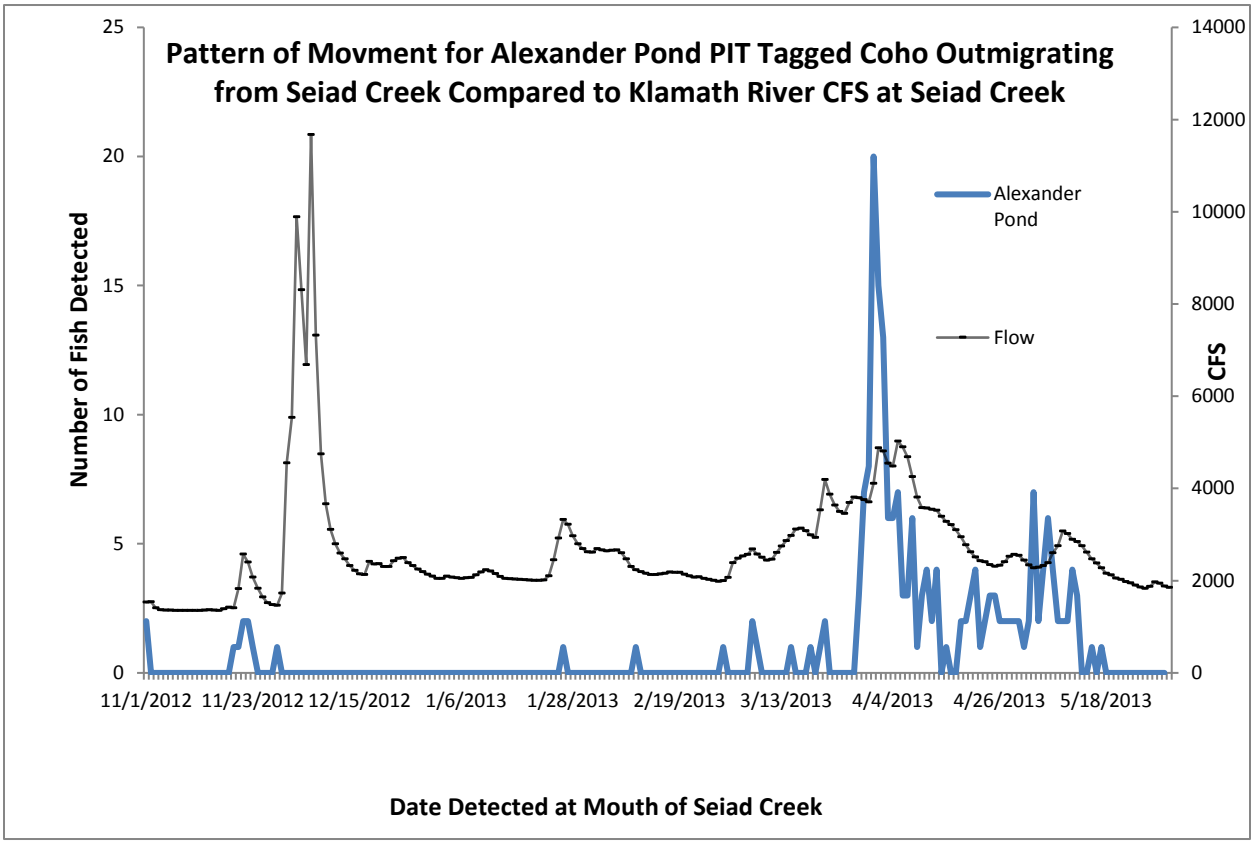

Figure 14. The chart shows Alexander Pond PIT tagged Coho detected leaving Seiad Creek compared to the mainstem Klamath River discharge (CFS) near Seiad Creek. The movement pattern shows fewer fish moved out during the fall and winter time period despite high winter flows and further shows a typical spring smolt migration pattern. The movement pattern suggests that winter rearing conditions in Alexander Pond were favorable.

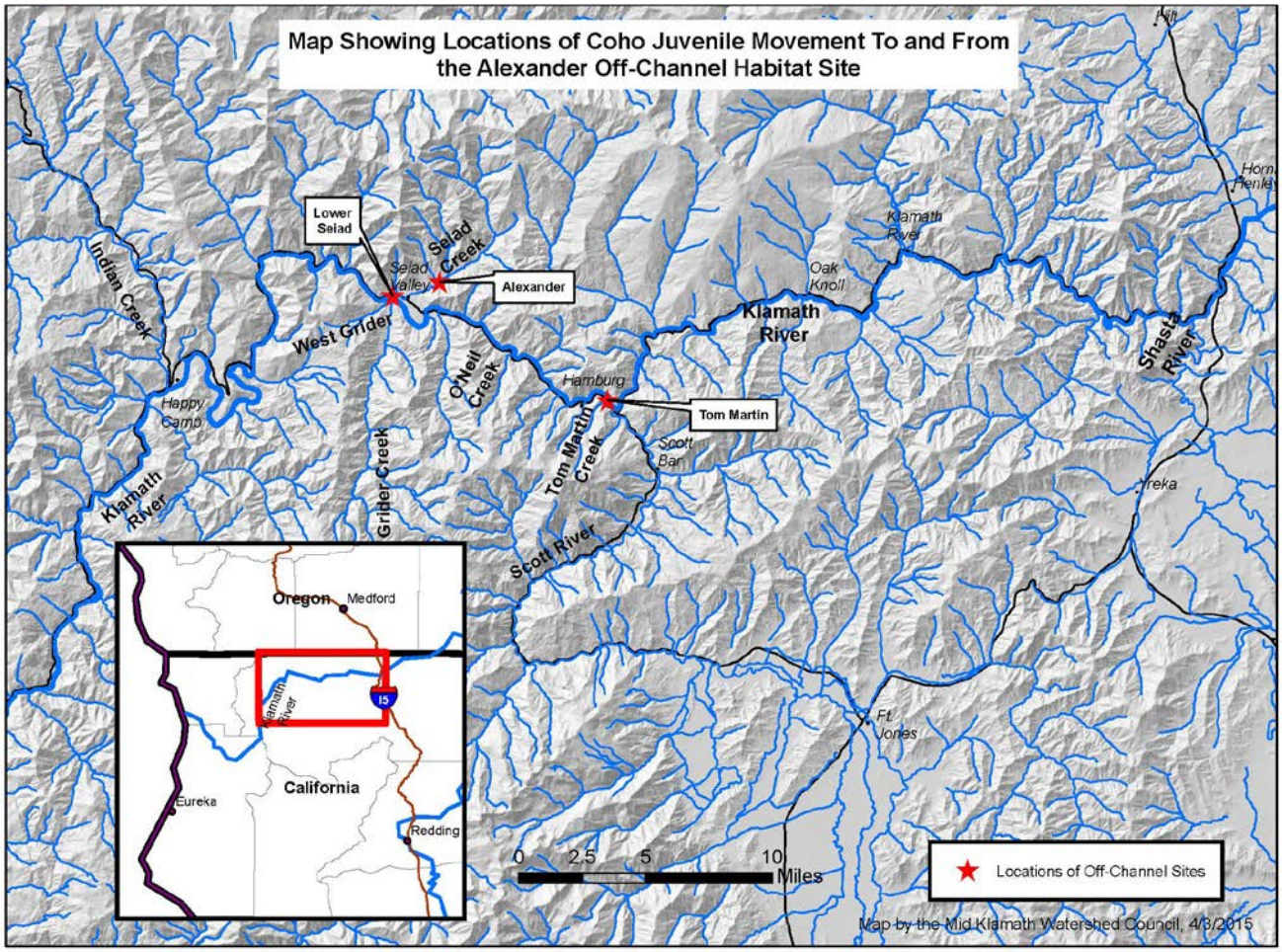

Figure 15 . Map of the non-natal coho tagging locations for fish that were recaptured in Alexander Pond.

Invertebrate Sampling

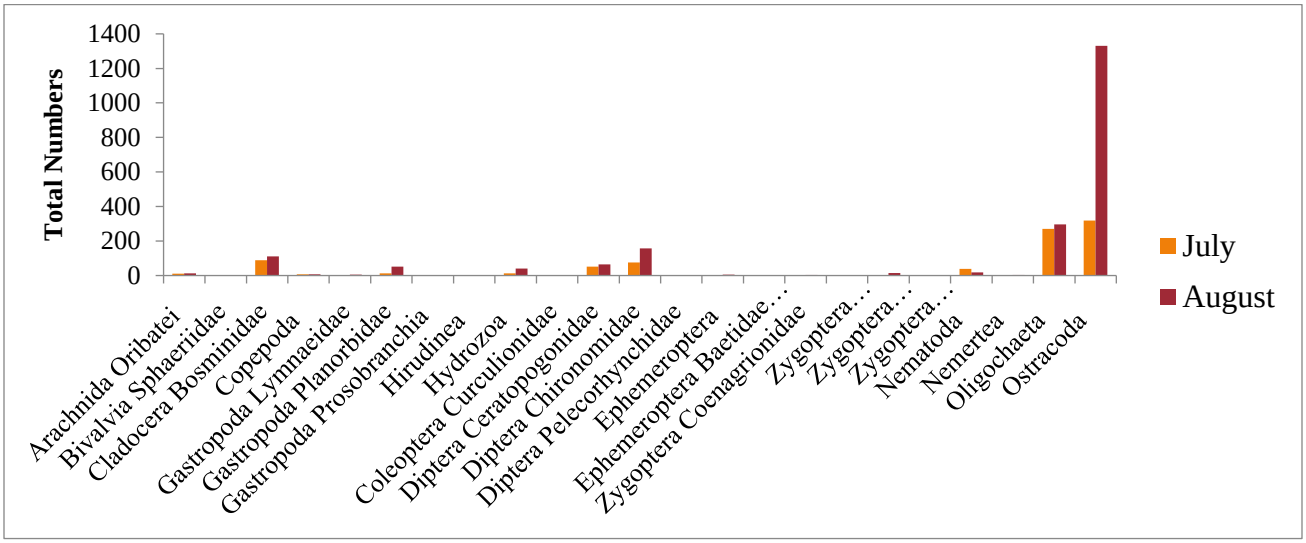

Figure 16 . Invertebrate sampling results from Hester-Dendy samplers deployed by Michelle Krall in July and August, 2014.

Connectivity

Deposition of fines within the ingress/egress channel occurs each winter at this site, and usually requires maintenance as flows drop out in the spring. Maintenance usually consists of a two person crew manually removing the fines with shovels and requires about five minutes twice a month (done in conjunction with bi-monthly water quality monitoring) through the spring.

Non-native/Invasive presence

We have not observed any non-native fish or amphibian species at this site, although Marlahan mustard (*Isatis tinctoria*), a non-native plant that is ubiquitous within the Seiad Valley, grows in the disturbed soils around the edges of the site. MKWC and volunteers pull these plants each spring, and the population seems to be diminishing.

Lessons learned/Next Steps

The Alexander Pond has shown some of the highest juvenile coho use of any of our constructed rearing habitats. One possibility is its location just downstream of a key spawning reach on lower Canyon Creek, and it's connection to the first large pool below the mouth of Canyon Creek. Other factors based on the findings of Shari Whitmore's thesis include pond depth and suitable summer temperatures and dissolved oxygen levels. Complex wood structures, a deep trench along the centerline of the pond, and high plankton levels also help to deter predation. One unique characteristic of the Alexander Pond is that the connection to Seiad Creek increases from two feet to nearly 20 feet during high flows. This may increase the ability for juvenile coho to find the site during high water events.

Alexander Pond has consistently held high numbers and multiple age classes of juvenile coho throughout the year since its construction in 2010. During recent droughts which are the most severe in recent recorded history, this pond continued to provide excellent juvenile coho rearing habitat. As riparian cover establishes and matures, summer conditions should improve. While some constructed ponds like Lower Seiad Pond can reach stressful temperatures for coho, if we construct future ponds to mimic the design features of Alexander Pond, we can help coho survive in stream systems where temperatures reach stressful or lethal levels.

The perennial issue of deposition at the outlet of this feature and others has encouraged us to reevaluate the design of subsequent project connections to their associated tributaries. The Alexander Pond was designed as a blind alcove, resembling an oxbow pond with an ingress/egress channel at the bottom of the feature for juvenile fish passage. The ingress/egress channel was designed to be no more than 3' wide at the connection point to Seiad Creek, under the assumption that a narrower connection point would minimize the volume of deposition. While this idea holds true (manual removal of deposition usually requires no more than 20-30 minutes each spring), the channel enters the mainstem creek at a 90 degree angle. This perpendicular angle dramatically increases the cross sectional distance of the creek at its connection point to the pond and allows sediment to settle farther into the outlet channel than desired from a maintenance standpoint. This may be valuable from a fish access standpoint given that coho are seeking low velocities during high water events.

Future project design based on consultation with Fiori Geosciences, Inc., will include modifying outlet channels that enter their associated tributaries at angles between 20 and 65 degrees in an effort to

reduce this cross-sectional distance and further discourage deposition. In addition, instream wood structures designed to create a sediment flushing hydrology at these connection points, while still maintaining low velocity “off-ramps” into the ponds would greatly benefit future projects. A recent proposal to the Fish and Wildlife Service Partners Program would remove excess sediment from the inlet, construct a wood structure to improve sediment transport at the inlet, and install cattle exclusion fencing to minimize the impacts from free range cattle on the pond and adjacent Seiad Creek.